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CERTAIN ASPECTS OF SHEET GLASS COLORING

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The Saratov Institute of Glass uses local raw materials with substantial deviations from standard parameters in production of thermally polished light- and heat-absorbing glass. A block system for prediction and fine correction of the color and light characteristics of tinted glass is developed in terms of using local material resources (sand, chalk, and dolomite).

The Saratov Institute of Glass for twenty years has been developing compositions and producing light- and heat-absorbing bulk-tinted sheet glass tinted in a metal melt.

The institute has developed a method and system for prediction and fine adjustment of the color and lighting parameters of glass. Glass coloring is based on salts, metal oxides, and metals.

By knowing the spectral parameters of the component colors (for example, the spectral transmission curves of pigments) and using the known properties of the pigments, the required color can be obtained in glass.

The nature of color centers is related to the equilibrium existing between the ionic and the molecular forms of the pigment, and the pigment itself forms in the glass matrix a diluted or undiluted solution reacting in a special manner with the glass matrix both in the short-range and long-range order [1]. The distribution of these color centers depends on the pigment distribution in glass and the type and quantity of the pigment.

A whole system of techniques for control of the glass coloring centers and, consequently, reproduction of a specific color with a certain precision has been developed for heat- and light-absorbing glass produced by the Saratov Institute of Glass. However, the initial raw materials already contain glass pigments represented by iron in different forms, sulfur in the form of sulfates, etc.

Owing to the existing situation on the market of glass materials and financial difficulties, the Institute is developing glass-melting and sheet glass coloring technologies based on local natural resources whose chemical and granulometric composition deviates from the standard parameters.

The present work presents the results of an investigation of the natural resources in the Saratov Region used for production of light- and heat-absorbing glass on the float-glass production line of the Saratov Institute of Glass.

Table 1 gives the typical differences in chemical composition between two batches of raw material, and Table 2 shows the admissible deviations for the content of the main oxides in the material.

TABLE 1

Material	Batch	Weight content, %				
		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO
Sand	1	97.40	1.35	0.37	0.37	0.32
	2	96.58	1.41	0.30	0.17	0.18
Dolomite	1	5.66	–	0.10	31.79	16.30
	2	2.17	0.15	–	29.21	19.48
Chalk	1	12.05	0.06	0.20	47.51	0.58
	2	3.92	–	0.04	51.76	0.52

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TABLE 2

Material	Regulating document	Weight content, %				
		insoluble residue	Al_2O_3	Fe_2O_3	CaO	MgO
Dolomite	GOST 23672–79	≤ 2.0	≤ 1.5 ≤ 0.1	32.0 ± 1.0	20 ± 10	
Chalk	GOST 23671–79	1.0 – 2.5	0.5 – 1.5	0.1 – 0.3	51.0 – 54.0	0.6 – 2.5
Sand	GOST 22551–77	98.5 – 99.8	0.1 – 0.6	0.01 – 0.07	Not subject to regulation	

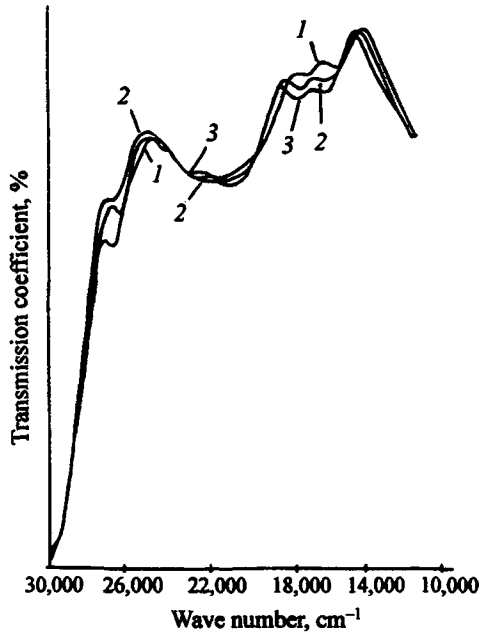

Fig. 1. Transmission spectra of sheet glass in the range of 330 to 1000 nm. *1* and *2*) Transitional glass samples taken 3 days apart; *3*) reference standard.

The data in Table 1 show that local material resources from the Saratov Region are not suitable for the production of clear sheet glass. Moreover, the unstable bedding depth and the interruptions in mining of raw materials make it hard to predict the variations in chemical composition and size for each batch of material.

In spite of all the shortcomings, local raw materials are successfully used by the Saratov Glass Institute due to the developed system of preparing and adjusting the batch composition and using coloring additives for production of tinted light- and heat-absorbing glass on the float-glass line owned by the Institute.

The combination of production techniques for batch and glass production makes it possible to obtain glass of different shades and, moreover glass of the same preassigned color with selective transmission of radiant energy. The color of glass of different thickness can be adjusted in compliance with the wish of the customer.

In order to reproduce a reference color, its spectral characteristis have to be obtained. The spectrophotometer is the basic instrument for evaluation of the color of industrially produced glass articles. For color assessment, the spectral transmission coeffcicient ought to be obtained for the entire range of the visible spectrum, i.e., for the wavelengths of 380 – 780 nm.

Given the spectral parameters of the component colors and knowing the spectral composition of the light illuminating the glass, the resulting color can be determined. The spectral composition of the resulting color is calculated by multiplication of the values of the light source radiation intensity by the transmission (reflection) coefficients of the component colors for the same wevelengths, and after that, the resulting curve is plotted.

At the Saratov Institute, spectrophotometric transmission curves are plotted using a Specord-M40 spectrophotometer equipped with an extension device for assessing the color characteristics of glass: color coordinates, chromaticity, color hue, color purity [2].

The glass transmission curves obtained using the instrument objectively reflect the variations in light transmission and, consequently, in the color of the glass. The maximum approximation of the light tramsmission curves of manufactured glass to the curves of the reference sample is the most precise evidence of the color identity.

The curves in Fig. 1 reflect the changes in the composition and ratio of the pigments carried out for the purpose of reproducing the color of the reference sample. These curves were obtained from samples of sheet glass produced on the float glass line of the Saratov Glass Institute in May 1997 in the course of transition to the glass color selected by the customer.

In addition to the color of the glass, a customer can be interested in the light transmission of the glass in different spectal regions: ultraviolet, visible, and infrared. These parameters are determined with a ShEL-72 instrument.

The combination of a specific technology and the means of quality support of preassigned light parameters of glass makes it possible to produce light- and heat-absorbing glass of different colors in compliance with customer requirements and to use local raw materials effectively.

REFERENCES

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